

**WHAT IS CLAIMED IS:**

1. A zone arc fault detection system for detecting arcing faults in a defined zone of an electrical circuit, such as an aircraft circuit, comprising:
  - a pair of substantially identical parallel insulated conductors for each zone in
  - 5 which arcing is to be detected, thereby defining a detection zone comprising the length of said parallel conductors between end points where the two conductors are coupled together;
  - a current sensor operatively associated with each said pair of parallel conductors, said current sensor and said conductors being respectively configured and arranged such
  - 10 that the current sensor produces a signal representative of a difference in current between the two conductors.
2. The system of claim 1 wherein said current sensor comprises a current transformer having a high permeability core.
- 15 3. The system of claim 1 wherein said current sensor comprises a Hall effect sensor.
4. The system of claim 1 wherein said current sensor comprises a low
- 20 magnetic permeability  $di/dt$  current sensor.
5. The system of claim 4 wherein said current sensor comprises an air core toroid.
- 25 6. The system of claim 5 wherein said current sensor comprises a flexible Rogowski coil formed into a figure 8 configuration.
7. The system of claim 4 wherein the current sensor produces a signal proportional to the difference between the time derivatives of the current in each
- 30 conductor and further including a circuit for integrating and filtering said sensor signal to produce a signal proportional to the current difference between said conductors.

8. The system of claim 1 wherein said current sensor comprises a resistive shunt constructed so as to produce a voltage difference proportional to the difference in current between said conductors.

5 9. The system of claim 1 wherein said current sensor comprises a magnetic core, said conductors being operatively coupled with conductors wound around a magnetic core such that magnetic fields of said conductors oppose each other.

10. The system of claim 9 and further including an armature attracted by said 10 magnetic core in response to a current difference in said conductors.

11. The system of claim 1 wherein said current sensor comprises a differential current sensor which produces a predetermined motion in response to the current difference between the conductors.

15 12. The system of claim 11 wherein said differential current sensor comprises a bi-metal element.

13. The system of claim 1 and further including a fault detector circuit 20 operatively coupled with said current sensor.

14. The system of claim 13 and further including a circuit breaker responsive to said fault detector circuit.

25 15. The system of claim 1 and further including a circuit breaker responsive to said differential current.

16. The system of claim 1 and further including a relay operatively coupled 30 with said circuit breaker, said relay being responsive to said differential current for operating said circuit breaker.

17. A method for detecting arcing faults in a defined zone of an electrical circuit, such as an aircraft circuit, comprising:

splitting a conductor in each said defined zone into a pair of substantially identical parallel insulated conductors, thereby defining a detection zone comprising the length of  
5 said parallel conductors between end points where the two conductors are coupled together;

providing a current sensor operatively associated with each said pair of parallel conductors; and

10 configuring and arranging a current sensor and said conductors such that the current sensor produces a signal representative of a difference in current between the two conductors.

18. The method of claim 17 wherein said current sensor comprises a current transformer having a high permeability core.

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19. The method of claim 17 wherein said current sensor comprises a Hall effect sensor.

20. The method of claim 17 wherein said current sensor comprises a low 20 magnetic permeability di/dt current sensor.

21. The method of claim 20 wherein said current sensor comprises an air core toroid.

25 22. The method of claim 21 wherein said current sensor comprises a flexible Rogowski coil formed into a figure 8 configuration.

23. The method of claim 20, including producing a signal proportional to the difference between the time derivatives between the current in each conductor and further 30 including integrating and filtering said sensor signal to produce a signal proportional to the current difference between said conductors.

24. The method of claim 17 wherein configuring and arranging said current sensor comprises constructing a resistive shunt so as to produce a voltage difference proportional to the difference in current between said conductors.

5 25. The method of claim 17 wherein configuring and arranging said current sensor comprises coupling said conductors with conductors wound in opposite directions around a magnetic core.

10 26. The method of claim 25 wherein configuring and arranging said current further includes providing an armature attracted by said magnetic core in response to a 15 current difference in said conductors.

15 27. The method of claim 17 wherein configuring and arranging said current sensor comprises providing a differential current sensor which produces a predetermined motion in response to the current difference between the conductors.

28. The method of claim 27 wherein said differential current sensor comprises a bi-metal element.

20 29. The method of claim 17 and further including coupling a fault detector circuit with said current sensor.

30 30. The method of claim 29 and further including providing a circuit breaker coupled for response to said fault detector circuit.

25 31. The method of claim 17 and further including providing a circuit breaker coupled for response to said differential current.

30 32. The method of claim 17 and further including operatively coupling a relay with said circuit breaker for responding to said differential current for operating said circuit breaker.